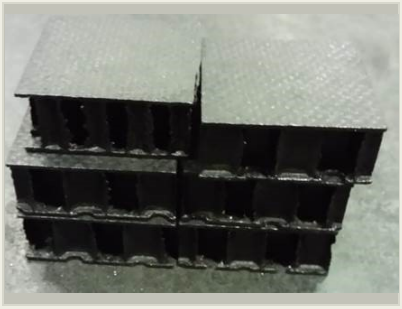
Ultra-Stable Zero-CTE HoneySiC and H2CMN Mirror Support Structures, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

NASA MSFC, GSFC and JPL are interested in Ultra-Stable Mirror Support Structures for Exoplanet Missions. Telescopes with Apertures of 4-meters or larger and using an internal coronagraph require a telescope wavefront stability that is on the order of 10 pico-meters RMS per 10 minutes. Interest is also for IR/FIR missions requiring 8-meter or larger diameter mirrors with cryogenic deformations <100 nm RMS. Fantom Materials is specifically responding to the need for ultra-stable mirror support structure traceable to the needs of Cosmic Origins for UVOIR, Exo and FIR telescopes, including mirror support structures, whiffle plates, delta frames and strongbacks. HoneySiC material has multiple features that make it very attractive as a potential future deployment hinge and latching material: 1) It's an additively manufactured Ceramic Matrix Composite (CMC) with no Coefficient of Moisture Expansion (CME). Individually molded parts become a monolithic construct, thus it is possible to manufacture an entire telescope using HoneySiC, 2) It's extremely light weight; laminate HoneySiC sheets have the same density as beryllium and honeySiC panels have about 1/5 the density of beryllium, 3) It's extremely dimensionally stable due to a zero-CTE across a temperature range of -200 to +25C. The thermal conductivity can be supercharged by addition of extremely high thermal conductivity carbon nanotubes. To achieve a stability of 10 picometer (e.g., LISA gravity wave detector mission) will require the distortion parameters to go to zero for a passive material. The overarching objectives of the project are to collaborate with NASA MSFC, GSFC, JPL and Northrop Grumman to demonstrate new mirror mounting materials with ultra-stability. Potentially every beryllium and M55J-954-6 part could be replaced by HoneySiC, resulting in a massive reduction in labor and schedule, as well as weight. Stiffness and dimensional stability would be greatly enhanced by HoneySiC or H2CMN.



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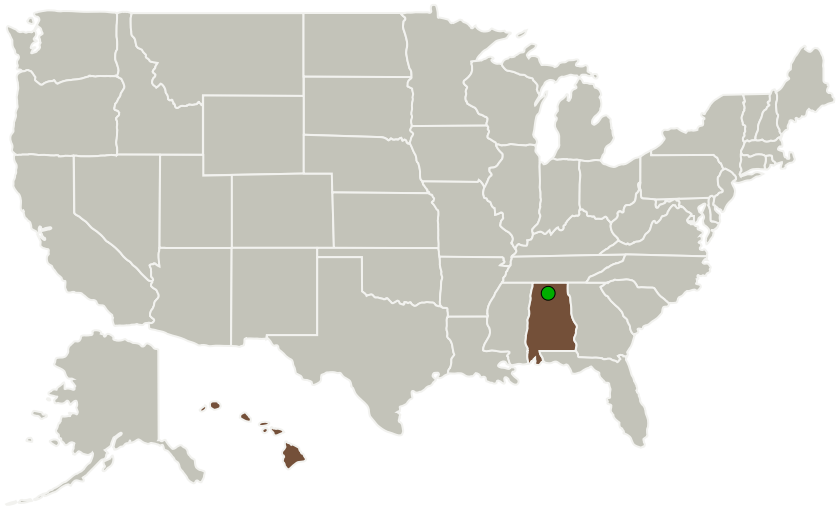
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Fantom Materials, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB), Historically Underutilized Business Zones (HUBZones)	Lihue, Hawaii
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Hawaii

Project Transitions

June 2016: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Fantom Materials, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

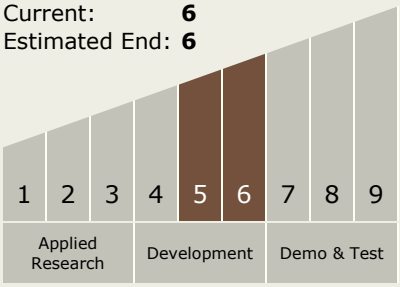
Carlos Torrez

Principal Investigator:

William Fischer

Technology Maturity (TRL)

Start: **5**
Current: **6**
Estimated End: **6**



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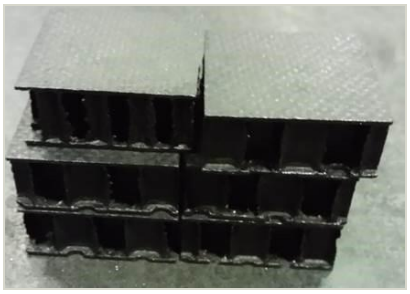
December 2016: Closed out

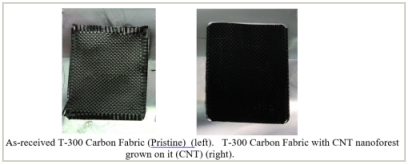
Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139674)*

Images



Briefing Chart Image
Ultra-Stable Zero-CTE HoneySiC and H2CMN Mirror Support Structures, Phase I *(https://techport.nasa.gov/image/128036)*



Final Summary Chart Image
Ultra-Stable Zero-CTE HoneySiC and H2CMN Mirror Support Structures, Phase I Project Image *(https://techport.nasa.gov/image/136460)*

Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.2 Structures and Antennas

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System